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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 501014.20004	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US03/12536	International filing date (day/month/year) 22 April 2003 (22.04.2003)	Priority date (day/month/year)
International Patent Classification (IPC) or national classification and IPC IPC: Please See Continuation Sheet USPC: 73/504.15;313/311,346R;257/10;438/20,52,53		
Applicant DARTY ET AL.		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>5</u> sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of ___ sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the report</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of report with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>		
Date of submission of the demand 18 November 2004 (18.11.2004)	Date of completion of this report 07 September 2007 (07.09.2007)	
Name and mailing address of the IPEA/US Mail Stop PCT, Attn: IPEA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Richard Elms <i>Lysia Deane Fox</i> Telephone No. (571) 272-1650	

Form PCT/IPEA/409 (cover sheet)(July 1998)

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US03/12536

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

☒ the international application as originally filed.☒ the description:

pages 1-18 as originally filed

pages NONE filed with the demand

pages NONE filed with the letter of \_\_\_\_\_

☒ the claims:

pages 19-31 as originally filed

pages NONE as amended (together with any statement) under Article 19

pages NONE filed with the demand

pages NONE filed with the letter of \_\_\_\_\_

☒ the drawings:

pages 1-7 as originally filed

pages NONE filed with the demand

pages NONE filed with the letter of \_\_\_\_\_

☐ the sequence listing part of the description:

pages NONE as originally filed

pages NONE filed with the demand

pages NONE filed with the letter of \_\_\_\_\_

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.  
These elements were available or furnished to this Authority in the following language \_\_\_\_\_ which is:☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in printed form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. ☐ The amendments have resulted in the cancellation of:☐ the description, pages NONE☐ the claims, Nos. NONE☐ the drawings, sheets/Fig NONE5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

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## V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. STATEMENT

Novelty (N)	Claims <u>7-10,15,16,44-47,59-62,65,66</u>	YES
	Claims <u>1-6,11-14,17-43,48-58,63,64,67-72</u>	NO
Inventive Step (IS)	Claims <u>NONE</u>	YES
	Claims <u>1-72</u>	NO
Industrial Applicability (IA)	Claims <u>1-72</u>	YES
	Claims <u>NONE</u>	NO

### 2. CITATIONS AND EXPLANATIONS Please See Continuation Sheet

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## Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of IPC:  
G01C 19/00( 2006.01);H01J 1/304( 2006.01);H01L 29/06( 2006.01),29/12( 2006.01)  
H01L 21/00( 2006.01)

Claims 1-6, 11-14, 17-43, 48-58, 63, 64, and 67-72 lack novelty under PCT Article 33(2) as being anticipated by Kang et al. (US 6132278).

Kang et al. disclose an apparatus, usable as an accelerometer, , and method for sensing at least one force applied to the apparatus (column 17 line 33 - column 18 line 52), said apparatus comprising: at least one nanostructure (column 11 lines 27-30) being suitable for emitting electrons; and, at least one collector (figure 24 number 35) proximately positioned with respect to said at least one nanostructure so as to receive said emitted electrons and define at least one gap therebetween that is at least partially dependent upon said applied force; wherein the apparatus comprises means for applying at least one electrical potential across said gap; wherein said emission and reception of said electrons is indicative of said applied force; wherein said at least one nanostructure and collector are operable (figure 25) in a first mode corresponding to a cutoff region for emissions and a second mode corresponding to substantially potential and gap dependent emissions; wherein said electrical potential is adapted to operate said at least one nanostructure in at least one of said modes in a first state and at least one other of said modes in response to said applied force; wherein said at least one nanostructure and collector are operable in a third mode corresponding to a saturation region for emissions; wherein at least a portion of said at least one nanostructure is adapted to be displaced in response to said applied force; wherein said at least one nanostructure provides a proof mass for sensing said applied force; further comprising a predetermined mass affixed to said at least one nanostructure; the apparatus further comprising at least one current sensor electrically coupled to said at least one collector and for detecting at least one current being indicative of said emission and collection; the apparatus further comprising a plurality of collectors (column 19 lines 19-32) each being proximately positioned with respect to said at least one nanostructure so as to receive said emitted electrons and define at least one corresponding gap therebetween that is at least partially dependent upon said applied force; wherein said at least one collector detects said emissions using spectral re-emission of energy, wherein said spectral re-emission is at least partially dependent upon an energy associated with electrons impacting said collector; wherein the gap is configured such that there is substantially no field emission in an absence of said applied force; wherein said at least one electrical potential across said gap is substantially constant; wherein at least said at least one nanostructure and collector are in a substantial vacuum chamber; further comprising a deflectable member supporting said at least one collector, wherein said gap is at least partially dependent upon deflection of said deflectable beam (figures 30 and 31); further comprising at least one support physically coupling said at least one nanostructure to said at least one collector; further comprising a proof mass mechanically coupled to said member; wherein said member comprises at least one beam, is mechanically coupled to, simply supported by, and fixedly coupled to said at least one support in a cantilevered manner; wherein said at least one member comprises at least one deflectable membrane (figures 27 and 28), wherein said membrane is suitable for deflecting in response to a pressure applied thereto, wherein said applied force corresponds to said applied pressure, further comprising a compartment containing at least one of a fluid and a gas exerting said pressure; wherein the apparatus is usable as a field emission based sensory device, further comprising at least one excitation pad (figure 36 number 28) electrically coupled to at least one of said plurality of nanostructures; wherein said at least one sensor comprises a plurality of sensors; wherein each of said sensors comprises at least one collector.

Form PCT/IPEA/409 (Continuation Sheet) (July 1998)

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## Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Claims 7-10, 44-47, and 59-62 lack an inventive step under PCT Article 33(3) as being obvious over Kang et al. (US 6132278) in view of Fan et al. (Science, vol. 283, pgs. 512-514).

Kang et al. do not disclose a nanostructure film comprising an array of self aligned carbon nanotubes suitable for emitting electrons and having ends affixed to at least one substrate. Fan et al. disclose a nanostructure film comprising an array of self aligned carbon nanotubes suitable for emitting electrons and having ends affixed to at least one substrate (figure 4). It would have been obvious at the time of invention to use the nanostructure film comprising an array of self aligned carbon nanotubes suitable for emitting electrons and having ends affixed to at least one substrate of Fan et al. as the electron-emitting nanostructure of Kang et al. because carbon nanotubes have been identified as promising candidates for field emitters (Fan et al. pg. 513 column 3 lines 17-19).

Claims 15, 16, 65, and 66 lack an inventive step under PCT Article 33(3) as being obvious over by Kang et al. (US 6132278) in view of Thundat (US 6212939).

Kang et al. do not disclose that the mass of a nanostructure is increased by molecular absorption of at least one substance to provide a proof mass and that the nanostructure comprises hydrogen. Thundat discloses that the mass of a nanostructure is increased by molecular absorption of at least one substance to provide a proof mass and that the nanostructure comprises hydrogen (column 1 lines 43-47). It would have been obvious at the time of invention to apply a surface coating, as taught by Thundat, to the device according to Kang et al. such that the mass of a nanostructure is increased by molecular absorption of at least one substance to provide a proof mass and that the nanostructure comprises hydrogen. The motivation for doing so would have been to enable the use of the device as a chemical sensor (column 1 lines 43-47).

US 6,212,939 B1 (Thundat) 10 April 2001, see column 1, lines 43-47